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**ORGANIZATIONAL DESIGN AND MANAGEMENT  
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# Organizational Design and Management Accounting Change

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## Abstract

Changing management accounting systems requires more than appropriate implementation. It is argued that structural characteristics of an organization, centralization in particular, should also be taken into account when deciding on a change. Centralization implies higher costs of communication because the decision-maker has to obtain information from organizational participants who have incentives to influence the decision. A limit on communication reduces influence costs but at the same time it also lowers the quality of the decision. As a result of that, centralized organizations (i) will implement changes in their accounting systems less often than decentralized ones (ii) will more often implement top-down, i.e. ignore local information.

**Keywords:** organizational design, management accounting change, centralization, influence costs.

JEL codes: M21, M41

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# 1 Introduction

This study contributes to the literature that seeks to understand when and why organizations introduce changes in their management accounting systems (MAS). In prior work addressing the question, two domains have been prominent - technical merit of a particular technique (e.g., Banker and Hughes, 1994, Banker and Johnston, 1993) and implementation issues (e.g., Foster and Swenson, 1997, Shields, 1995).

We emphasize the importance of an additional domain and argue that organizational design has implications for changing MAS of a firm. Organizational design implies a firm specific distribution of incentives, information and decision rights (Zimmerman, 1997). These structural factors are potentially the major cause of organizational resistance to a MAS change. Implementation process factors (e.g., clear objectives, training of users) may play a secondary role. Adequate implementation may alleviate resistance but cannot remove the underlying structural cause (Markus and Pfeffer, 1983). Recent empirical research provides evidence that is in line with this argument (Anderson and Young, 1999; Gosselin, 1997).

We model the effect of centralization<sup>1</sup> - one of the key organization design factors - on the process of MAS change. Centralization has probably been the most prominent structural factor in the empirical work studying MAS design and changes (Gosselin, 1997; Libby and Waterhouse, 1996; Gul and Chia, 1994; Chenhall and Morris, 1986). Additionally, there is extensive theoretical work on centralization (Aghion and Tirole, 1997; Baiman and Rajan, 1995; Melumad and Reichelstein, 1987) highlighting its importance in organizational design.

The decision to adopt and implement a MAS change is analyzed in a framework drawing on the lobbying literature (Che and Gale, 1998). The decision-maker has to obtain information on the value of the MAS change from organizational participants who will be affected by the change. Communication with them is both costly and in-

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<sup>1</sup>In line with the literature, we define centralization as the extent to which authority is confined to higher levels of the hierarchy. Decentralization entails delegation of authority.

formative. The communication costs in centralized organizations, where the distance between the decision-maker and those who have the information is larger, are higher than in decentralized organizations. Given this assumption, we derive that centralized organizations will optimally implement fewer MAS changes and implement top-down (ignoring local information) more often than decentralized organizations.

The rest of this section provides more detail and an example of the problem we want to address. In subsection 1.1, we argue that an important distinction between centralized and decentralized structures arises due to communication costs. Subsection 1.2 shows that MAS change will give rise to extraordinary communication costs due to influencing activities. Section 2 presents a model that captures the core of the problem and section 3 derives implications of the model. We discuss them and conclude in the last section.

## **1.1 Centralization and costs of communication**

Centralization implies communication costs because knowledge has to be transferred to the person who has decision rights. Under decentralization the decision rights are transferred to the person who has the knowledge, which gives rise to agency costs (Christie et al., 1992). The trade-off between agency and communication costs determines the optimal level of centralization. A key insight of the theoretical literature is that when the revelation principle (Myerson, 1982) applies, a centralized structure will always (at least weakly) outperform delegation in solving the agency problems (Melumad et al., 1997). Within that framework, one cannot explain why delegation is such a common arrangement in practice. That is why recent theories depart from the assumptions of the revelation principle. The assumption of costless communication seems to be an obvious target. Melumad et al. (1997, 1992) solve the incentive problem with an exogenous restriction on communication and contracting. They show that when communication is limited, delegation dominates centralization.

Similarly, the starting point of our analysis is that communication costs can be

reduced by delegation of authority. Rather than looking for the optimal degree of centralization, our study points out the implications of different degrees of centralization for the process of MAS change. The interesting aspect of the question is that we can no longer assume that communication is a routine information exchange. MAS themselves are the routine information technology, that's why any MAS change will be a special event with a nontrivial communication problem. The next section describes it in more detail.

## 1.2 MAS change and Cost of Communication

MAS are an established information technology and there are multiple users of MAS output. Consequently, MAS design is a result of compromising different information demands. In our setting, it is important to recognize that managers at higher levels of a hierarchy will have different information needs than managers at lower levels. The following example based on a real problem of a company<sup>2</sup> illustrates the conflict that arises when a MAS change is considered.

A large multinational firm producing consumer goods has several operating companies in most major European markets. The firm focuses on a single line of business but production lists of its companies differ widely. Each company produces a different number of products and has a different mixture of local and European brands.

The firm was concerned with production efficiency in some companies and planned to reorganize the production of its European brands. The firm launched a firm-wide benchmarking program. To be able to rely on accurate products cost information, the firm decided to implement activity-based costing (ABC) in all of its companies. The ABC project met with resistance in some companies. They argued that ABC will not bring anything to them because they either produce very few product items (i.e. cost allocations are not a major issue) or focus mainly on local brands that will not be affected by the reorganization. Still, to assure comparability of cost information, these companies were asked to switch to the ABC system.

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<sup>2</sup>Its name and further details are confidential and cannot be presented here.

The example illustrates the need for comparable cost information at higher management levels. It also points out that local information needs are company-specific (dependent on cost structure, product portfolio) and have to be compromised sometimes.

Many MAS changes are likely to be subject to a similar conflict. On the one hand, there is the essential demand of high level managers for uniformity of MAS, on the other, there are specific needs of local users whose opinions on a MAS change may differ greatly. Preserving the uniformity of MAS requires that benefits from a change for some users be traded-off against costs that the change imposes on others. Moreover, only users themselves know the magnitude of these benefits or costs. This is why the previous section described MAS changes as special events with a non-trivial communication problem. The decision-maker has to obtain information from parties who will be affected by the decision. Milgrom (1988) and Milgrom and Roberts (1988) point out that this creates incentives for influence activities.

There are several analytical structures that model influence activities within an organization<sup>3</sup>. Moreover, the problem of information exchange with interested parties has been dealt with in the lobbying literature (e.g., Lohmann, 1995; Potters and Van Winden, 1992 ). A large part of this work (e.g., Che and Gale, 1998; Baye et al., 1993) applies analytical models that are closely related to auction theory (e.g., Laffont and Robert, 1996; Amann and Leininger, 1996). The common feature of this literature is a setting in which two or more agents compete for one good. The core problem is how to design a mechanism that would be optimal given the preferences of the mechanism designer. As the lobbying literature points out, the same problem occurs when a decision that affects the utility of the agents is to be taken. They have an incentive to spend resources on influencing the decision, which may be socially wasteful.

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<sup>3</sup>Schaeffer (1998) applies the concept of influence costs to organizational change, Rottenberg and Saloner (1995) model the interfunctional conflict within organizations, Bagwell and Zechner (1993) and Meyer et al. (1992) analyze the relationship between headquarters and divisions and divestiture activities.

We apply these insights to learn more about the organizational process of MAS change. Besides that, we contribute to the underlying analytical literature in two ways. First, we extend the framework analyzing the effect of a limit on the lobbyists' contributions (Che and Gale, 1998). In our model, it is possible to derive the optimal limit endogenously by explicitly modeling the preferences and information of the decision-maker. Second, drawing on the influence cost literature, we find a way to incorporate information benefits of lobbying into the widely used auction-based models.

## 2 Analytical Framework

This section presents the analytical framework we use to address the research question: what is the effect of centralization on the process of MAS change. Subsection 2.1 discusses the assumptions of our model, which we describe in more detail in subsections 2.2, 2.3 and present its equilibrium in 2.4. Finally, we check the robustness of the results by modifying the information structure of the model in subsection 2.5.

### 2.1 Assumptions

The assumptions below underlie the analysis:

**Assumption 1.** The impact of a MAS change is not distributed evenly across departments in a firm.

Decision-making benefits from any accounting change are situation specific. They depend on factors that vary across departments, such as cost structure, management style, etc. Hence, we can assume that MAS change would increase profits in one department, while it would not be worth the costs in another.

**Assumption 2.** It is not possible to restrict implementation to only those departments that can benefit from the MAS change.



Whenever there are multiple business units (functional departments) in a firm, MAS uniformity becomes an essential prerequisite for planning and control. Performance measures, benchmarking or limited processing capacity at higher levels requires standardization of internal reporting and MAS practices. The accounting literature provides numerous examples of situations when corporate headquarters imposed an accounting technique on the divisions, even though it limited their ability to use MAS as a support for local decision-making (Jones, 1992; Colignon and Covaleski, 1988; Jones, 1985). Therefore we assume that MAS changes cannot be implemented only in the business units (functional departments) that can benefit from it.

**Assumption 3.** The degree of centralization and compensation are not adjusted to reflect specific circumstances of a MAS change.

Anderson and Young (1999) and Shields (1995) find that performance evaluation and compensation are not altered to create a link with ABC implementation. We suggest the following explanation. Compensation and delegation of authority are essential building blocks of organizational design. These building blocks are put in place for a long period of time and require stability (Foster and Ward, 1994). Altering them to address short term issues, such as MAS change implementation, would have adverse long term consequences. Thus, we assume that the design elements are unaffected by a particular MAS change. This does not preclude the possibility that they were ex-ante chosen in a way that reflected the expected impact of future MAS changes.

**Assumption 4.** Transfer of knowledge from the agents to the principal is more costly in a more centralized environment.

In a decentralized organization, the decision-maker is close to the people who possess relevant information. It is relatively inexpensive to obtain it as the decision-maker has enough knowledge to understand the information, and recognize that it is

relevant and true. In centralized organizations, decision rights are located at higher organizational levels. The distance between the decision-maker and the level where information is present becomes larger. As a consequence, lower level managers have to report the information through a more costly process. This observation is in line with McAfee and McMillan (1995), and Jensen and Meckling (1992).

## 2.2 Basic Model

To address our research question, we model the interactions of a principal and two agents. The principal (she) is the decision-maker who is responsible for MAS design. The agents are two competing departments within the firm. Agent 1 (he) is in favor of the change, agent 2 (he) is against it (assumption 1 and 2). Each agent knows what the change implies for his department's contribution to firm's profitability,  $\theta_i$  ( $i = 1, 2$ ). Let  $\theta_1$  be the increase in the profit of agent's 1 department due to the change and  $\theta_2$  the decrease in the profit of agent's 2 department (the costs of the change are higher than its benefits for this department). For the principal,  $\theta_i$  is a realization of  $\Theta_i$ , a stochastic variable with a uniform distribution on the interval  $[0, 1]$ .  $\Theta_1$  and  $\Theta_2$  are independent. The agents may or may not have better information than the principal about the opponent's type. Therefore, we compare two complementary cases. In what follows, we first assume that the agents know as much as the principal about the opponent's type, i.e. the distribution of  $\Theta_i$  only. Second, in section 2.5 we consider the case where the agents have perfect information about the opponent's type, while the principal still knows only the distribution of the types.

Following the empirical literature (Krumwiede, 1998; Gosselin, 1997), we distinguish two different stages of the change process: adoption and implementation. The *adoption stage* refers to information gathering and evaluating whether the suggested MAS change is suitable for the firm. During the *implementation stage* the initial idea of MAS change translates into its practical realization. Implementation is contingent upon the information collected in the adoption stage. The principal decides first on

adoption of the change:

$$\begin{aligned} A &= 1, & \text{if the change is adopted,} \\ &= 0, & \text{if the change is not adopted.} \end{aligned} \quad (1)$$

A positive adoption decision ( $A = 1$ ) allows the agents to search for relevant information and to present it to the principal. Depending on the information they provide during this stage, the principal decides whether to implement. For  $A = 1$ , we define:

$$\begin{aligned} I &= 1, & \text{if the change is implemented,} \\ &= 0, & \text{if the change is not implemented.} \end{aligned} \quad (2)$$

If  $I = 1$ , agent 1 can increase his department's profit by  $\theta_1$ . If  $I = 0$ , agent 2 can prevent a decrease of  $\theta_2$ . Both agents can exert *influencing effort*  $e_1$  and  $e_2$  to persuade the principal to make their favored decision. The influencing effort will result into some *departmental influence costs*,  $d_i(e_i)$ . To simplify notation, we assume  $d_i(e_i) = e_i$ . Thus, the agent's pay-offs are:

$$\begin{aligned} U_1^A(e_1) &= \theta_1 - e_1, & \text{if } I = 1 \\ &= -e_1, & \text{if } I = 0 \end{aligned} \quad , \quad \begin{aligned} U_2^A(e_2) &= -\theta_2 - e_2, & \text{if } I = 1 \\ &= -e_2, & \text{if } I = 0 \end{aligned} \quad (3)$$

Risk aversion is not central to our problem, therefore we assume that agents are risk neutral, i.e. they maximize their expected pay-off (see (12) in appendix). Note that compensation does not affect the agent's pay-offs in the game as it is invariable in the process of MAS change (assumption 3). An additional implicit assumption is that the existing compensation plan provides incentives to maximize departmental profit.

The principal is also risk neutral, i.e. when making the adoption and implementation decisions, she maximizes expected firm profits. If she refuses to adopt the change ( $A = 0$ ), the game ends and all players receive zero as a payoff. By adopting ( $A = 1$ ), the principal opens communication channels with the agents. Their influencing efforts are informative but also costly. The principal incurs fixed *adoption costs*,  $C^A$ . Moreover, the agents' influencing efforts,  $e_i$  ( $i = 1, 2$ ), cause *organizational influence costs*,  $C(e_1, e_2, c)$ . The parameter  $c$  reflects the degree of centralization. It is higher for more centralized organizations (assumption 4). The principal can reduce  $C(e_1, e_2, c)$  by approving a limited amount of time or money to be spent on searching for and

presenting of information<sup>4</sup>. Let us denote this limit on  $e_i$  as  $L$ . (The influencing effort is a function of the agents' types and the limit,  $e_i(\theta_i, L)$ . In what follows,  $e_i$  denotes also realizations of this function.)

After the adoption stage, the principal decides on implementation. She can revise the adoption decision and reject the implementation ( $I = 0$ ). If she implements, the firm's profits change by  $\theta_1 - \theta_2$ . Formally, her pay-off is:

$$U^P(A, I) = \begin{cases} B(I) - C(e_1, e_2, c) - C^A, & \text{if } A = 1, \\ 0, & \text{if } A = 0, \end{cases} \quad (4)$$

where  $B(I)$ , *MAS change value*, and  $C(e_1, e_2, c)$ , *organizational influence costs*, are defined as follows:

$$B(I) = \begin{cases} \theta_1 - \theta_2, & \text{if } I = 1, \\ 0, & \text{if } I = 0, \end{cases} \quad (5)$$

$$C(e_1, e_2, c) = c(e_1 + e_2)^2. \quad (6)$$

The definition of  $C(e_1, e_2, c)$  reflects that the influencing effort has different implications for an agent and for the principal, i.e. the firm as a whole. As the total amount of time spent on influencing increases, negative externalities related to it accumulate increasingly. Excessive influencing results in a preoccupation with internal problems and organizational politics, which is detrimental to the performance. Moreover, this problem is especially severe for centralized organizations (Milgrom and Roberts, 1992; Burns and Waterhouse, 1975), which is captured in the definition by  $c$ .

The influencing efforts,  $e_i$ , cause organizational influence costs but reveal information as well. Depending on his effort, each agent produces some amount of messages,  $m_i(e_i)$ , in favor or against the change. To simplify the problem, we assume  $m_i(e_i) = e_i$ . Thus, having observed  $e_1$  and  $e_2$  the principal can revise her expectations of the MAS change value and, if necessary, revise the adoption decision.

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<sup>4</sup>The idea of restricting influencing efforts is similar to Milgrom and Roberts (1988) who argue that a solution to avoid influence costs is to close the communication channel.

### 2.3 Time line and solution concept

The previous section described the basic building blocks of the game. Here, we first summarize it in a time line and then introduce the solution concept.

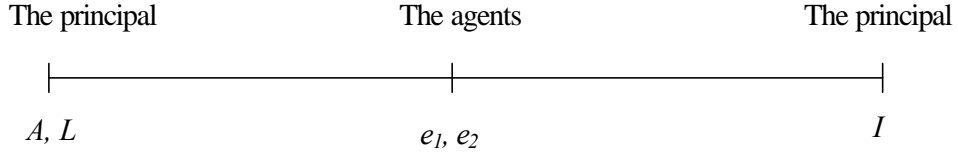


Figure 1: Time line

Figure 1 depicts the timing of the moves in the game. Before the first move,  $\Theta_i$  is assigned values of the agents' types  $\theta_i$  ( $i = 1, 2$ ). The game proceeds as follows:

1) The principal decides on adoption of the change,  $A$ . She knows the distribution of the agents' types,  $\Theta_i$ , the fixed costs of adoption,  $C^A$ , and the cost implications of the agents' influencing efforts,  $C(e_1, e_2, c)$ . If  $A = 0$ , the game ends. If  $A = 1$ , the principal simultaneously chooses the limit  $L$ .

2) Having observed  $L$ , the agents simultaneously determine their influencing effort  $e_1$  and  $e_2$ . They know their own type and the distribution of the opponent's type.

3) Having observed  $e_1$  and  $e_2$ , the principal makes her final decision on implementation. She can revise her adoption decision and reject the change. All payoffs are realized and the game ends.

We can apply backward induction to solve the game. The principal's implementation strategy in the third move depends on the agents' strategies in the second move. On the other hand, the agents' strategies depend not only on the  $L$  chosen in the first move but also on how the principal decides on the implementation in the third move. In equilibrium, all players will correctly predict the optimal strategies of the other parties. Therefore, we first look for a Bayesian Nash equilibrium (see, e.g., Mas-Colell et al., 1995) of the subgame that consists of the second and third moves of the overall game, given a fixed  $L$ . Second, knowing the equilibrium strategies of the principal

and the agents given a fixed  $L$ , we look for the optimal  $L$  in the first move.

## 2.4 Results

Given that  $L$  was chosen in the first move, denote by  $I^*(L)$  the equilibrium implementation strategy of the principal in the third move. Further, denote  $e_i^*(L)$  as the equilibrium influencing effort of the agents in the second move. It is a function of both  $\theta_i$  and  $L$  but we omit the former argument so as to save notation.

The following proposition describes the equilibrium strategies in the subgame (moves 2, 3):

**Proposition 1** *Given a limit  $L$  on the agents' influencing effort, the agents simultaneously choose the following strategies:*

$$\begin{aligned} e_i^*(L) &= \frac{\theta_i^2}{2}, & \text{if } \theta_i \in [0, 2L], & \quad i = 1, 2, \\ &= L, & \text{if } \theta_i \in (2L, 1]. \end{aligned} \tag{7}$$

*Having observed  $e_1$  and  $e_2$  the principal will make the implementation decision in the following way:*

*If  $e_1 > e_2$ , then  $I^*(L) = 1$ .*

*If  $e_1 < e_2$ , then  $I^*(L) = 0$ .*

*If  $e_1 = e_2$ , the principal randomizes,  $P(I^*(L) = 0) = P(I^*(L) = 1) = \frac{1}{2}$ .*

**Proof.** For a proof see appendix 5.1. ■

The agents face a trade-off. The influencing effort,  $e_i$ , decreases their pay-off but increases the chances that they will persuade the principal to make their favored decision  $I$ . Being a higher type results in higher influencing effort as the pay-off from persuading the principal (winning) increases. In equilibrium, the principal predicts this behavior and infers from  $e_1 > e_2$  ( $e_1 < e_2$ ) that  $\Theta_1 > \Theta_2$  ( $\Theta_1 < \Theta_2$ ). All costs are sunk at this stage, hence  $\Theta_1 > \Theta_2$  ( $\Theta_1 < \Theta_2$ ) implies a positive (negative) implementation decision. When  $e_1 = e_2$ , the principal is indifferent about implementation.

The equilibrium requires that the principal can set the limit  $L$  credibly, and the agents will not ignore it. Credibility of the principal's commitment is indeed a problem in many settings where influence costs occur (Rotemberg and Saloner, 1995). Ex ante commitment may not be credible for the principal if ex post there are some convincing arguments. Here,  $L$  represents a limit in terms of time or money the agents are given to conduct search and present their results. When the time is over, or the allowed budget is spent, the agents simply cannot search any further.

Proposition 1 allows us to analyze the optimization problem the principal faces in the first move when she chooses the limit  $L$ . The lower the limit  $L$ , the lower are the *expected organizational influence costs* but the less information is revealed and the lower is the *expected MAS change value*. The optimal limit maximizes the principal's expected pay-off:

$$L^* = \arg \max_{L \in [0, \frac{1}{2}]} \{E[B(I^*(L)) - C(e_1^*(L), e_2^*(L), c) - C^A]\}. \quad (8)$$

$C^A$  are the fixed adoption costs.  $E[C(e_1^*(L), e_2^*(L), c)]$ , the *expected organizational influence costs*, follow directly from (6) and proposition 1 by integrating over all possible combinations of types  $\theta_1, \theta_2$ . The *expected MAS change value* can be derived as follows<sup>5</sup>:

$$\begin{aligned} E[B(I^*(L))] &= E[\max_{I=0,1} E[B(I) \mid e_1^*(L), e_2^*(L)]] = E[(\Theta_1 - \Theta_2)1_{e_1^*(L) > e_2^*(L)}] \\ &= E[(\Theta_1 - \Theta_2)1_{\Theta_2 < \Theta_1 < 2L}] + E[(\Theta_1 - \Theta_2)1_{\Theta_1 \geq 2L, \Theta_2 < 2L}] \\ &= \int_0^{2L} \int_0^{\theta_1} (\theta_1 - \theta_2) d\theta_2 d\theta_1 + \int_{2L}^1 \int_0^{2L} (\theta_1 - \theta_2) d\theta_2 d\theta_1 \\ &= \frac{4}{3}L^3 + L - 2L^2. \end{aligned} \quad (9)$$

The function is increasing in  $L$  on the interval  $[0, \frac{1}{2}]$ . Thus, the influencing efforts generate information benefits. We illustrate that with two extreme examples:

$$\begin{aligned} E[B(I^*(L))] &= E[\Theta_1 - \Theta_2] = 0, & \text{if } L = 0. \\ &= E[(\Theta_1 - \Theta_2)1_{\Theta_1 > \Theta_2}] = \frac{1}{6}, & \text{if } L = \frac{1}{2}. \end{aligned}$$

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<sup>5</sup>The notation  $E[(\Theta_1 - \Theta_2)1_A]$  stands for the expectation taken over all pairs  $\theta_1, \theta_2$  for which  $A$  is true.

The principal will not implement when  $e_1 < e_2$ . She will infer that  $\Theta_1 < \Theta_2$  and set  $I^*(L) = 0$ , by proposition 1. If  $L = 0$ , then  $e_1 = e_2 = 0$ , and the expectation is taken over all realizations of  $\Theta_1$  and  $\Theta_2$ . If  $L = \frac{1}{2}$ , the principal can identify all the cases where  $\theta_1 < \theta_2$ . This increases the expected MAS change value, because the profit will not be negatively affected by them.

Knowing how the expected MAS change value and the expected organizational influence costs depend on  $L$  allows us to solve the principal's optimization problem (8) and to state the following proposition.

**Proposition 2** *The game of three players described in section 2.2 has a Bayesian Nash equilibrium consisting of the following strategies:*

(1) *The principal imposes the optimal limit  $L^*$  and makes the adoption decision as follows:*

$$\begin{aligned} A^* &= 1, & \text{if } E[B(I^*(L^*)) - C(e_1^*(L^*), e_2^*(L^*), c) - C^A] > 0, \\ A^* &= 0, & \text{otherwise.} \end{aligned}$$

(2) *The agents and the principal play according to the strategies described in proposition 1.*

**Proof.** The proposition largely summarizes the preceding paragraphs. The optimal adoption decision is straightforward. We omit the proof. ■

Before we look at the properties of this equilibrium, we consider a modification of the game.

## 2.5 The case of completely informed agents

The previous section considered the case where the agents do not have better information than the principal about the opponent's type. When deciding on the optimal influencing effort in the second move, they know only the distribution of  $\Theta_i$ . In practice, it is conceivable that the manager of one department knows more than the headquarters about the implications of a MAS change for another department. Therefore, we also consider the complementary case of completely informed agents



(who know both  $\theta_1$  and  $\theta_2$ ) in order to understand how the findings depend on the assumed information structure.

The game remains virtually the same. The only thing that changes is that, in the second move of the game, the agents simultaneously choose  $e_1$  and  $e_2$  knowing the opponent's type. Let  $\theta_h = \max\{\theta_1, \theta_2\}$  and  $\theta_l = \min\{\theta_1, \theta_2\}$ , similarly for  $\Theta_i$  and  $e_i$ . We can state the following proposition which parallels proposition 1:

**Proposition 3** *Given a limit  $L$ , the agents choose their strategies so that:*

$$\begin{aligned} e_1^*(L) + e_2^*(L) &= \frac{\theta_l(\theta_h + \theta_l)}{2\theta_h}, & \text{if } L > \frac{1}{2}\theta_l, \\ &= 2L, & \text{if } L < \frac{1}{2}\theta_l. \end{aligned} \quad (10)$$

*Having observed  $e_1$  and  $e_2$  the principal will make the implementation decision,  $I^*(L)$ , in the same way as described by proposition 1.*

**Proof.** For the proof of the first part of the proposition see Che and Gale (1998)<sup>6</sup>. The second part concerns the optimal implementation strategy.  $I^*(L)$  does not change because it still holds that:

$$\begin{aligned} e_1 > e_2 &\Rightarrow E[\Theta_1 - \Theta_2 \mid e_l^*(L), e_h^*(L)] > 0, \\ e_1 < e_2 &\Rightarrow E[\Theta_1 - \Theta_2 \mid e_l^*(L), e_h^*(L)] < 0, \end{aligned}$$

which can be verified by applying the results for the individual influencing strategies in Che and Gale (1998). ■

The fact that the agents know their types forces them to randomize when the limit is sufficiently high. For simplicity, we do not reproduce the individual mixed strategies, only their sum which is sufficient to calculate the expected organizational influence costs.

The expected MAS change value is also different under the new information structure. Due to randomization, it may happen with a small probability that  $e_1 < e_2$  ( $e_1 > e_2$ ), although  $\theta_1 > \theta_2$  ( $\theta_1 < \theta_2$ ). As a result of that the information benefits from influencing decrease. We omit the explicit expressions for  $E[B(I^*(L))]$  and

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<sup>6</sup>There are multiple equilibria in the case  $L = \frac{\theta}{2}$ . This occurs with zero probability and can be omitted in our framework.

$E[C(e_1^*(L), e_2^*(L), c)]$  as they add little beyond what was presented in the previous section. The new optimal limit  $\tilde{L}^*$  follows from (8). It is different from  $L^*$ , but all the qualitative conclusions presented in the next section hold under both information structures.

### 3 Implications for Adoption and Implementation

The previous sections derived the optimal trade-off between costs and benefits of the influencing effort. It can be used to generate insights about the effect of centralization on the adoption and implementation of a MAS change. The optimal limit will depend on the degree of centralization. It will be denoted in this section as  $L^*(c)$  and in the case of complete information as  $\tilde{L}^*(c)$ . All properties of the function  $L^*(c)$  derived below hold also for  $\tilde{L}^*(c)$ .

**Proposition 4** *The expected value of a MAS change in centralized organizations will be lower than the expected value of the same MAS change in decentralized organizations.*

**Proof.** Solving the optimization problem (8) yields the function  $L^*(c)$ . It can easily be verified that  $\frac{\partial L^*(c)}{\partial c} < 0$  (recall that the parameter  $c$  is high for centralized organizations). It follows from (9) that  $\frac{\partial E[B(I^*(L))]}{\partial L} > 0$ . ■

This proposition points out an important finding of this study. Organizational influence costs have both a direct and an indirect negative effect. While the direct costs of influencing activities can be restricted, this will only be at the price of losing information for the decision making process. The next proposition shows the implications for the *adoption decision*.

**Proposition 5** *Centralized organizations will optimally adopt less MAS changes than a decentralized organizations.*

**Proof.** Take any two values of parameter  $c$ , (e.g.  $\bar{c}$  for a centralized organization and  $\underline{c}$  for a decentralized organization), such that  $\bar{c} > \underline{c}$ . Let  $C^A$ , the fixed costs of adoption, depend on the type of MAS change that is considered for adoption. It can easily be verified that for all  $C^A$  such that:

$$\begin{aligned} E[B(I^*(L^*(\bar{c}))) - C(e_1^*(L^*(\bar{c})), e_2^*(L^*(\bar{c})), \bar{c})] &< C^A \\ E[B(I^*(L^*(\underline{c}))) - C(e_1^*(L^*(\underline{c})), e_2^*(L^*(\underline{c})), \underline{c})] &> C^A \end{aligned}$$

the following is true:

$$E[U^P(L^*(\bar{c}))] < 0 \quad \text{and} \quad E[U^P(L^*(\underline{c}))] > 0.$$

Consequently,  $A^* = 0$  for the centralized organization and  $A^* = 1$  for the decentralized organization. ■

Considering any particular MAS change, there is always some chance that  $C^A$  is such that the change will be adopted in a decentralized organization but rejected in an organization with a higher degree of centralization. In other words, centralized organizations are less likely to adopt changes in their MAS.

Further, our analysis has implications for the *implementation process*. When  $e_1 \neq e_2$ , the principal decides on implementation after having obtained all the relevant information from the agents. If  $e_1 = e_2 = L^*(c)$ , the decision to implement is based on randomization. Such an implementation process can then be characterized as top-down because it does not reflect the relevant information available at lower levels. It would be too costly to obtain it.

**Proposition 6** *Centralized organizations that adopt a change are more likely to implement it top-down, without obtaining all the information available at lower levels in the organization.*

**Proof.** Denote  $p(c)$  the probability that  $e_1^* = e_2^* = L^*(c)$ . As  $\frac{\partial L^*(c)}{\partial c} < 0$ , it can easily be verified that  $p(\bar{c}) > p(\underline{c})$  under both information structures. ■

The conditional probability of implementation, given that adoption occurred, does not vary with the degree of centralization. What differs is the way the implementation decision is made. In centralized organizations, it will frequently happen that MAS change is implemented top-down without knowing whether the benefits are higher than the costs of the MAS change.

Although we do not model the implementation stage explicitly (to avoid an overly complex setting), we can speculate under what conditions centralized organizations would be more likely to complete implementation once a MAS change was adopted (Gosselin, 1997). Shifts in the environment can cause the agents' types,  $\theta_i$ , to randomly change after the implementation decision (e.g. when a new pressing issue arises, the opportunity costs of MAS change increase). The equilibrium of this modified game would closely parallel our results because all the parties are risk neutral. The difference is that implementing MAS change with communication channels closed ignores signals about increased costs of MAS. It will happen less often that MAS change implementation is halted due to shifts in the environment. Thus, centralized organizations in a changing environment would be more likely to finish implementation, once it started.

## 4 Discussion and Conclusions

Recent literature in organizational economics has addressed implications of influence costs for organizational design (see footnote 2). In this study, we have used these insights to look at the implications for an organizational change process. We have applied them to the process of management accounting change because it is a prime example of change involving two features central to the analysis: a decision-maker not informed about local information needs, and competition among the informed parties. This is due to the conflict inherent in the functioning of MAS, given that it is used both for control and decision-making.

Our findings suggest that the adoption and implementation process of a MAS

change will differ among organizations with different degrees of centralization. Optimal change process for centralized organizations encompasses two features. First, there will be a relatively high threshold that expected profit from MAS change has to meet. Below the threshold, change will not even be considered and no further information will be sought (i.e. project will not even reach the adoption stage). Second, top-down implementation will be relied upon more frequently, even though this may sometimes lead to implementation of an undesirable change.

There are also limitations to the generalizability of our results. First, we have assumed that there are two organizational groups, one opposing, one supporting the change. We can expect that this will mostly be the case, but it is not difficult to imagine MAS changes that will not be too controversial. The key trade-off analyzed in our framework would not apply to these cases.

The second limitation comes from the fact that the only means of information transmission in our analysis is competition between agents. Although Milgrom and Roberts (1992) suggested that "competition among interested parties with opposing interests may offer the best chance for all the relevant facts and desirable alternatives to be effectively advocated", our conceptualization of such an information revelation might be too restrictive. We do not allow for the possibility that one of the parties finds a crucial piece of information with little effort. More (better) evidence can only be presented to the principal through more search effort ( $m_i(e_i) = e_i$ ).

Notwithstanding these limitations, there are studies whose findings validate our results. Zaltman et al. (1973) present, and the innovation literature frequently apply, the "ambidextrous model" of innovation which suggests that low formalization and low centralization facilitate the initiation of innovations. The opposite structure is instrumental in the implementation stage. Gosselin (1997) found that the degree of centralization has a significant effect on what level of activity management is adopted and then implemented. In his study, he distinguishes less formal and less sophisticated levels (activity and cost driver analysis) and then the full formal ABC. Vertically

differentiated companies were found to adopt the full ABC system rather than the simpler activity analysis. Even more interestingly, when centralized organizations adopted ABC, they also went on with the implementation, while the decentralized organizations would often stop the implementation process at some activity analysis level (i.e., deviate from the original plan).

Our findings also shed some light on the developments in management accounting practices in the past. It has often been argued that management accounting is lagging behind developments in the production environment. Martinez and Jarillo (1989) provide evidence that the degree of centralization differs across functional areas and that the finance function is more centralized than other parts of the organization. Whether the same applies to MAS design still needs to be tested. But if the accounting department is more centralized than others, then it is in line with our theory that MAS are relatively rigid and it takes a major innovation such as ABC for changes to occur on a large scale.

## 5 Appendix

### 5.1 Proof of Proposition 1

First, we prove that  $I^*(L)$  as described in the proposition is optimal for the principal given that the agents' strategies are (7).

Given  $L$ , the principal will maximize  $E[U^P(1, I)]$ , her expected pay-off, when making the implementation decision:

$$I^*(L) = \arg \max_{I=0,1} E[B(I) - C(e_1, e_2, c) - C^A \mid e_1^*(L) = e_1, e_2^*(L) = e_2]. \quad (11)$$

From (5) we know that:

$$\begin{aligned} E[U^P(1, 1)] &= E[\Theta_1 - \Theta_2 - C(e_1, e_2, c) - C^A \mid e_1^*(L) = e_1, e_2^*(L) = e_2], \\ E[U^P(1, 0)] &= E[-C(e_1, e_2, c) - C^A \mid e_1^*(L) = e_1, e_2^*(L) = e_2]. \end{aligned}$$

We can see that all the costs incurred in the adoption process are sunk and do not influence the decision.

$$E[U^P(1, 1)] \geq E[U^P(1, 0)] \Leftrightarrow E[\Theta_1 - \Theta_2 \mid e_1^*(L) = e_1, e_2^*(L) = e_2] \geq 0.$$

Knowing (7) and having observed  $e_1 > e_2$ , the principal can infer that  $\Theta_1 > \Theta_2$ . Consequently:

$$\begin{aligned} e_1 > e_2 &\Rightarrow E[\Theta_1 - \Theta_2 \mid e_1^*(L) = e_1, e_2^*(L) = e_2] > 0 \\ &\Rightarrow E[U^P(1, 1)] > E[U^P(1, 0)] \\ &\Rightarrow I^*(L) = 1. \end{aligned}$$

Equivalent argument yields that  $e_1 < e_2$  implies  $I^*(L) = 0$ . Finally:

$$\begin{aligned} e_1 = e_2 &\Rightarrow E[\Theta_1 - \Theta_2 \mid e_1(\Theta_1, L) = e_1, e_2(\Theta_2, L) = e_2] = 0 \\ &\Rightarrow E[U^P(1, 1)] = E[U^P(1, 0)] \end{aligned}$$

The principal is indifferent and any randomization is possible. Yet, as we show below, only randomization with probability  $\frac{1}{2}$  can be maintained in the equilibrium.

Secondly, we prove that given  $I^*(L)$ , the agents will find it optimal to choose the strategies as in (7). This part of the proposition was proved in a general form by Laffont and Robert (1996). Here, we present a simple proof for our specific case.

Without loss of generality we derive the optimal strategy of agent 1, given that (7) is optimal for agent 2. He maximizes his expected pay-off:

$$E[U_1^A(e_1)] = P_1(I^*(L) = 1)\theta_1 - e_1, \quad (12)$$

where  $P_1(I^*(L) = 1)$  is the agent's interim probability of winning reflecting his private information  $\theta_1$ . Given that  $e_1 \in [0, L]$  and agent 2 chooses his strategy in line with (7), we can specify the probability of winning:

$$\begin{aligned} P_1(I^*(L) = 1) &= P_1(e_2 < e_1) + \frac{1}{2}P_1(e_2 = e_1 = L) \\ &= P_1((\Theta_2 < \sqrt{2e_1}) \cap (\Theta_2 \leq 2L)) + \frac{1}{2}P_1(\Theta_2 > 2L)1_{e_1=L}. \end{aligned}$$

The second expression on the right-hand side is the probability that both agents influence  $L$  and the principal randomizes, i.e. the agent has  $\frac{1}{2}$  chance of winning. The agent's expected pay-off follows:

$$E[U_1^A(e_1)] = \sqrt{2e_1}\theta_1 - e_1, \quad \text{if } e_1 \leq 2L^2 \quad (13)$$

$$= 2L\theta_1 - e_1, \quad \text{if } 2L^2 < e_1 < L, \quad (14)$$

$$= \frac{2L+1}{2}\theta_1 - L, \quad \text{if } e_1 = L. \quad (15)$$

First, compare (13) and (14). It is never optimal to influence  $e_1 \in (2L^2, L)$  because additional effort decreases pay-off without increasing the probability of winning (notice that for  $L \in (0, \frac{1}{2})$  it is always true that  $2L^2 < L$ ). Second, the first order condition corresponding to (13) yields  $e_1 = \frac{\theta_1^2}{2}$ . The highest expected pay-off the agent can get if he influences  $e_1 \leq 2L^2$  is  $U_1^A(\frac{\theta_1^2}{2}) = \frac{\theta_1^2}{2}$ . Third, compare (13) and (15). It can be easily verified that for  $\theta_1 = 2L$  the agent can do equally well under (13) and (15). For  $\theta_1 < 2L$  choosing  $e_1 = \frac{\theta_1^2}{2}$ , i.e. (13), is optimal. For  $\theta_1 > 2L$  choosing  $e_1 = L$ , i.e. (15), is optimal. ■

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